

MI DEQ & RETAP Pollution Prevention (P2) Training

Metal Fabrication: Cutting & Stamping

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Types of Metal Fabrication Wastes

- ☐ **Corrosive**
- ☐ **Waste Water**
- ☐ **Used Oils**
- ☐ **Solvents**
- ☐ **Sludges**
- ☐ **Metalworking Fluids**
- ☐ **Solid Wastes**

Corrosive Wastes

- ☐ **Spent pickling acids**
- ☐ **Spent alkaline cleaning solutions**
- ☐ **Discarded molten-bath, alkali-salt cleaning mixtures**

Sludges

- ☐ Treatment of electroplating, heat-treating or anodizing waste water
- ☐ Paint-related sludges
- ☐ Grinding sludge
- ☐ Clean-out solvent or aqueous systems, sumps or grease traps
- ☐ Distillation still bottoms

Waste Water

- ☐ **Electroplating systems**
- ☐ **Anodizing systems**
- ☐ **Parts cleaning systems (acidic or alkaline)**
- ☐ **Water-curtain spray booths**
- ☐ **Paint stripping systems**
- ☐ **Floor washing (Maintenance & Housekeeping)**
- ☐ **Cooling systems & Boiler blow-down**
- ☐ **Domestic sewage**

Metalworking Fluids

- ☐ **Cutting oils: Fortified petroleum oils**
- ☐ **Soluble oils:**
30 - 90% oil
- ☐ **Semi-synthetic fluids:**
1 - 30% oil
- ☐ **Synthetic fluids: 0 - 1% oil**

Used Oils

- ☐ **Metalworking fluids**
- ☐ **Hydraulic oils**
- ☐ **Lubricating oils**
- ☐ **Compressor oils**
- ☐ **Motor oils**
- ☐ **Oil Filters**
- ☐ **Oil-soaked absorbent materials**
- ☐ **Shop Towels**

Solvent Wastes

- ☐ **Degreasing items before Painting or Plating**
- ☐ **Removing metalworking fluids**
- ☐ **Cleaning manufacturing equipment**
- ☐ **Cleanup of painting equipment**
- ☐ **Solvent evaporation**

Sources of Solvent Wastes

- ☐ **Vapor degreasers**
- ☐ **Paint spray booths**
- ☐ **Paint mixing & cleaning stations**
- ☐ **Drying & curing ovens**
- ☐ **Sinks, tubs & vats used for cleaning parts & dies**
- ☐ **Manual cleaning products: rags, containers, sprayers & aerosol cans**

Solid Wastes

- ☐ **Metal Wastes**
- ☐ **Paper Products**
- ☐ **Aerosol cans**
- ☐ **Fluorescent Tubes**
- ☐ **Packaging & Shipping wastes:**
 - ☐ **Wooden pallets, crates & boxes**
 - ☐ **Steel drums, pails, straps & cans**
 - ☐ **Plastic drums, pails, stretch wrap & straps**
 - ☐ **Expanded polystyrene**
 - ☐ **Aluminum cans**

Metal Cutting & Stamping

- ❑ Key to P2 for both is effective fluid management**
- ❑ Main types of cutting fluids—pros & cons**
- ❑ What fluids do**
- ❑ Components of a fluid environmental management program**
- ❑ Fluid recycling & disposal**

Metal Cutting & Stamping

- ☐ **Common cutting fluid functions**
 - ☐ **Cool**
 - ☐ **Lubricate**
 - ☐ **Remove fines/cuttings from cutting zone**
 - ☐ **Corrosion protection (esp. ferrous materials)**
- ☐ **Choice of coolant affects tool wear & part quality (surface finish and size).**
- ☐ **No one type of cutting fluid provides best cooling & lubrication. Generally a tradeoff.**
- ☐ **Fewer coolants are easier to manage in a shop.**

Types of Fluids

Oil-based (100% petroleum)

- ✓ **excellent lubricity (cushioning) allows use in severe machining & difficult-to-cut metals**
- ✓ **good rust protection**
- ✓ **easy maintenance**
- ✓ **extended sump life**
- ✓ **resistant to bacterial growth**
- ✓ **poor heat dissipating qualities**
- ✓ **higher fire risk**
- ✓ **mist generation**
- ✓ **limited to low-temperature/low speed & severe cutting operations**
- ✓ **oil on part often requires cleaning**

Types of Fluids

Oil-based (60-90% petroleum)

- ✓ **improved cooling capabilities**
- ✓ **good lubrication due to oil & water blending**
- ✓ **general purpose product for light and medium duty on ferrous & non-ferrous metals**
- ✓ **water increases susceptibility to rusting, bacterial growth & evaporative losses**
- ✓ **higher maintenance costs**
- ✓ **can be difficult to clean (oily film)**

Types of Fluids

Synthetic (0% petroleum)

- ✓ **superior cooling & corrosion control**
- ✓ **suitable for wide range of machining**
- ✓ **reduced misting & foaming**
- ✓ **easily separated from workpiece & chips, less dragout & easier cleanup**
- ✓ **long service life**
- ✓ **moderate to high agitation causes foam & some mist generation**
- ✓ **may emulsify tramp oil**
- ✓ **may form residue**
- ✓ **easily contaminated by other machining fluids**

Types of Fluids

Semi-synthetic (2-30% petroleum)

- ✓ **good corrosion control, cooling & lubrication**
- ✓ **easily separated from workpiece/chips**
- ✓ **long service life**
- ✓ **suitable for many machining operations**
- ✓ **moderate to high agitation causes foam & some mist generation**
- ✓ **may emulsify tramp oil**
- ✓ **may form residue**
- ✓ **easily contaminated by other machining fluids**

Costs of Poor Fluid Quality

- ❑ Increased machine & tool wear**
- ❑ Impaired part quality/increased reject costs**
- ❑ Increased machine downtime**
- ❑ Increased fluid purchase, mix & disposal costs**
- ❑ Increased labor costs associated with all the above**

Metal Cutting & Stamping

P2 Opportunities

- ☐ **Use high-quality metalworking fluid**
- ☐ **Select right fluid for job**
- ☐ **Maintain equipment to prevent sump contamination (cleaning sump & machine, gasket, wiper & seal maintenance)**
- ☐ **Proper fluid monitoring & cleaning**
- ☐ **Assigned fluid control responsibility**
- ☐ **Separate metal & fluid waste**

Components of a Fluid Management Program (FMP)

❑ Commitment from interested parties

- ❑ Top management (time, money, leadership focus)**
- ❑ Employees (“how-to” input)**
- ❑ Vendor (technical know-how on fluid/equipment)**

❑ Defined roles & responsibilities

- ❑ Initially to gather baseline performance data**
- ❑ Then to sustain monitoring, measurement & maintenance of FMP**

Components of a Fluid Management Program (FMP)

❑ Establish operational controls

- ❑ Fluid control points: water quality requirements (e.g., water hardness & dissolved solids), water/concentrate ratios, contaminant levels & pH**
- ❑ Work instructions**
 - ✓ roles & responsibilities, control points & how-to measure, mixing & maintaining fluids, annual cleanout**

Components of a Fluid Management Program (FMP)

☐ Contaminants to watch for...

- ☐ Tramp oils—leak into sump from other machine parts. Can be any other oils from machine or parts. Can contribute to next problem...**
- ☐ Bacterial growth: problematic in water-miscible fluids. Bacteria lower fluid pH, increasing tool/part corrosion & staining, dissolve chips/fines, possibly making fluid hazardous waste come disposal time**

Components of a Fluid Management Program (FMP)

☐ And how to prevent them...

☐ Tramp oils

- ✓ Find and fix leaks through proactive preventative maintenance
- ✓ Remove metal chips/fines (i.e., “yellow-bellied sump sucker”)
- ✓ Skim/centrifuge fluid to remove

☐ Bacterial growth

- ✓ Control water quality (e.g., dissolved minerals)
- ✓ Maintain proper fluid concentration & pH
- ✓ Routine maintenance & cleaning of machines, lines, & sumps
- ✓ Biocide additions
- ✓ Aeration

Components of a Fluid Management Program (FMP)

☐ Monitoring & measurement-fluid concentration

- ☐ Refractometers: measures fluid concentration by sending light through fluid. The more it refracts or bends, the higher the fluid concentration.**
- ☐ Titration: slower but typically more accurate than refractometers for fluid concentration. Less affected by contaminants.**

Components of a Fluid Management Program (FMP)

☐ Monitoring & measurement: pH

- ☐ Litmus paper: quick & inexpensive but accurate to +/- one full pH unit**
- ☐ pH meter: more expensive (\$50-\$200 dollars) but accurate to +/- 0.2 pH units**

☐ Monitoring & measurement: bacteria

- ☐ Plate counts/dipslide tests—both inexpensive. Recommended testing weekly or biweekly especially during program startup**

Components of a Fluid Management Program (FMP): Recordkeeping

[illegible]

Fluid Cleaning & Recycling

- ☐ **Skimmers**
- ☐ **Coalescers**
- ☐ **Centrifuging**
- ☐ **Hydrocycloning**
- ☐ **Filtration**
- ☐ **Pasteurization**
- ☐ **Flotation**

“Cutting-Edge” P2 Opportunities

- ☐ **Air as fluid replacing cutting oils**
- ☐ **Laser-cutting**
- ☐ **Water-jet cutting**
- ☐ **Plasma-arc welding**
- ☐ **CNC (computer numerical control)
machining**

Additional Resources

- ❑ **North Carolina Waste Reduction Resource Center, Waste Reduction for Metal Machining**
<http://wrrc.p2pays.org/industry/metalmach.htm>
- ❑ **Cutting Fluid Management for Small Machining Operations: A Practical Pollution Prevention Guide, Iowa Waste Reduction Center, University of Northern Iowa, 1996**
- ❑ **EPA Guide to Pollution Prevention: The Fabricated Metal Products Industry, EPA/625/7-90/006, July 1990**

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Next Steps: Assess Cutting & Stamping Operations & Implement a FMP!

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